

## NOTES AND COMMENTS

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### MYRMECOPHILY IN KEROPLATIDAE (DIPTERA: SCIAROIDEA)

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The Keroplatidae, a family of the Sciaroidea (fungus gnats), are a cosmopolitan group, and, although they are encountered frequently, very little has been published on their biology. Matile (1990) revised the Arachnocampinae, Macrocerinae and Keroplatini, and included information, where known, on immature stages.

Keroplatid larvae spin silk webs and are either predaceous or fungal spore feeders. The most complete account of the natural history of any predaceous member of this family can be obtained from the numerous papers on the New Zealand Glow worm, *Arachnocampa luminosa* (Skuse), a fungus gnat with luminous larvae (see Pugsley, 1983, 1984, for a review of the literature and ecology of the species, and Matile, 1990, for morphology and a summary of biology). The biology of the Palearctic spore-feeder *Keroplatus tipuloides* Bosc is fairly well known (Santini, 1982). As regards the Neotropical region, very few larvae of keroplatids have been discovered, but there are good accounts of the behavior of the predaceous larvae of *Neoditomyia* Lane & Stürm (Stürm, 1973; also Jackson, 1974, under the generic name *Orfelia*, and Decou, 1983, for a cave-dwelling species). Duret (1974) and Matile (1982) reported the discovery of presumably spore-feeding larvae belonging respectively to *Platyroptilon* Westwood, in Argentina, and *Placoceratias* Enderlein, in Guadeloupe, on rotten wood invaded by polyporaceous fungi, but no description of the morphology or ethology of these larvae has been given.

We here present information on the larva and pupa of a carnivorous keroplatid, *Proceroplatus belluus* Matile, from El Copé (elevation 750 m), Republic of Panama. It is a predator of ants, as are recently discovered Oriental species of keroplatids belonging to the same tribe, but to different genera (Kovacs and Matile, in press; Matile and Chandler, in press.; Krombein et. al., in press).

On 9 November 1992, during a study of the ant-plant *Besleria formicaria* Nowicke (Gesneriaceae), the inflated vesicles near the base of the leaf blade of that plant were sliced open longitudinally to permit examination of the ants (*Pheidole* sp.), ant brood, and ant refuse deposits inside (Windsor and Jolivet, 1996). Seven of these vesicles were occupied by peculiar elongate larvae (one per vesicle) that were 1.5-2 cm long and about 1 mm in diameter (Figs. 1, 2). The larvae were clear, except for a brownish head, and were rounded at the head end and narrowed towards the posterior end. The head bore brown mandibles, a lateral reddish spot in the position where stemmata might be expected, and above and in front of each reddish spot, a large, clear circle representing the antennae. The head was followed by three telescoped thoracic segments and an elongate, seemingly segmentless body. Each larva rested on a strand of silk that ran the length of the vesicle and was held in position, at intervals, by perpendicular silk threads that connected it to the vesicle walls. Elongate, white, septate blobs of sticky mucus were present on some of the short silk threads. The



Figs. 1–6. Figures 1–4. The fly, *Proceroplatus belluus*. 1. Fly larva (the black arrow points to the head end) in its natural position within the plant vesicle (sliced open longitudinally); 2. Head end of the fly larva, resting on its mucus-covered silk strand; 3. Fly pupa, suspended among silk lines; 4. Adult fly. Figures 5 and 6. The wasp, *Megastylus panamensis*. 5. Wasp cocoon, with pupa within; 6. Adult wasp and empty cocoon.

larvae, which appeared to have neither prolegs nor true legs, glided along the silk threads on a bed of clear slime. They reversed direction by turning the head and doubling back on themselves, on the same silk thread.

Not knowing what the larvae were feeding upon, we placed the occupied vesicles into individual petri dishes inside of ZipLoc bags, numbered them, and attempted to keep the larvae moist but well ventilated, while waiting for them to present some useful clues. On 12 November, all seven larvae still were alive, but five of them had abandoned their vesicles and gone between the leaf and the petri dish or were found gliding about the dish. We returned each to its vesicle.

On 14 November, larva no. 6 was consumed by a fungus that sent out white fluff all along its body. We placed the larva in water, brought it to a boil, then preserved

it in 80% ethanol. One by one, more larvae succumbed to the same fate, until by 17 December only two were left.

On 23 November, when there were still three larvae left (nos. 3-5), it occurred to us that the larvae might be feeding on dead ants or other dead animal matter, so we added several freshly crushed *Pheidole* ants taken from a potted *B. formicaria*. The next day, we found that the ants had been dismembered and the larvae had dark, irregular fragments in their guts.

On 1 December, because the original vesicles were decomposing, we placed each larva on top of a fresh piece of *B. formicaria* leaf. The leaf pieces had a variety of creatures living in the water film among the trichomes on them: mites, Collembola, small worms (nematodes?), and tiny clear Crustacea. We added several freshly crushed *Pheidole* and some ant garbage from the vesicles of a fallen *B. formicaria* leaf. By the next day, all three larvae had set up fresh silk-mucus threads, their guts were full of dark brown particles, and the ants had been dismembered and compacted into mucus-covered masses.

On 9 December, we added a live mosquito to each of two dishes. The next day, the two larvae in those dishes had full guts, and the third one did not. The mosquitoes had been caught on the silk and were partially dismembered and coated with mucus. It appears that the larvae are able to capture live prey, not just scavenge.

By 15 December, the fly larvae were becoming opaque. On 17 December, larva no. 5 died. On 24 December larva no. 4 was consumed by the endoparasitic larva of a parasitoid wasp. We must assume that the fly larva already was parasitized when collected, as there was virtually no possibility of access by a wasp when in culture. Upon termination of feeding, the wasp larva made a pale beige, fine silk cocoon (Fig. 5), 7 mm long and 2 mm in diameter, and rounded at the ends. The cocoon was transparent enough that a white, annulated larva could be seen inside. Incorporated into the head end of the cocoon were the remains of the fly larva. It was not possible to discern exactly when pupation took place, but on 29 December the wasp pupa began to take on color; the petiole and the sides of the abdominal segments were black, and the thorax was brown. By the next day, the adult had emerged but remained inside the cocoon. A pool of amber liquid and a compressed white shed skin filled the posterior end of the cocoon. On 31 December, an adult ichneumonid wasp emerged (Fig. 6). It had an orangish thorax and clear wings with black markings; the rest of the body was black. Dr. David Wahl identified the ichneumonid as a previously undescribed species of *Megastylus* (subfamily Orthocentrinae); it is described as *Megastylus panamensis* Wahl (Wahl, 1997). Orthocentrines are presumed to be koinobiont endoparasitoids of nematoceros Diptera (Wahl, 1990, 1997), and this rearing represents the first direct confirmation.

Meanwhile, on 26 December, fly larva no. 3 shortened and the thorax became wider than the head. On 28 December, it pupated among the silk strands; no cocoon was made (Fig. 3). The pupa began to darken on 1 January 1993. The thorax was beige, the legs were dark gray because of the darkening setae on them, the eyes were black, and setae were beginning to show on the dorsum of abdominal segments 1-4. By 2 January, the fly appeared to be fully formed inside the pupal skin. The antennae were very broad and pectinate, the wings were dusky, the legs were black with setae, and the abdomen was clothed in black setae. The adult fly (Fig. 4) eclosed on 3 January. Dr. Loïc Matile identified the fly as belonging to the sciaroid family



Keroplastidae, Keroplastinae, tribe Orfelliini and representing an undescribed species of *Proceroplatus* with pectinate antennae. He named it *P. belluus*, in reference to the pet name, "monster," that we applied to the larva. All known larvae of Orfelliini are predaceous (Matile, pers. comm.).

The fly specimen is in the collection of the Paris Museum, and the wasp is at the American Entomological Institute (Gainesville, Florida). Both are labelled as Aiello Lot 92-87.—Annette Aiello and Pierre Jolivet, *Smithsonian Tropical Research Institute, Box 2072 Balboa, Ancon, Republic of Panama; and 67 Boulevard Soult, 75012 Paris, France.*

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